SYNTHESIS OF HYBRID NANOCARBON MATERIALS BY SELF-ASSEMBLY

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Keywords: Hybrid nanocarbon, ultrananocrystalline diamond, carbon nanotubes, self assembly, plasma chemistry.

Abstract

Research interest on nanocarbons has been promoted by the discovery of carbon nanotubes and the emergence of CVD nanocrystalline diamond films. The different combinations of the configurations of electronic states of carbon atoms and short/long order of the bonds lead to different form of nanocarbons and provide them with unique properties. The synergistic combination of different forms of nanocarbon in order to take advantages of their unique properties has the potential of yeielding materials with novel properties that could be used advantageously in applications such as nanoelecronics, protective coatings, and energy related technologies. In this presentation, we report our recent results on the synthesis and integration of various nanocarbon materials.

Various nanocarbons, including ultrananocrystalline diamond (UNCD) and CNTs, have been synthesized by using tailored hydrogen-poor Ar/CH_4 plasma chemistry, temperature and growth templates. The process for simultaneous growth of UNCD and CNTs was established for the first time and different configurations of integrations of UNCD and CNTs were obtained by self-assembly. Scanning and transmission electron microcopies (SEM & TEM), Raman Spectroscopy, and Near Edge X-ray Absorption Fine Structure (NEXAFS) confirmed the coexistence of ultrananocrystalline diamond (UNCD) and CNTs in the hybrid material, and also the direct covalent bonding of the two materials. Isolated diamond clusters interconnected with CNTs as well as fully-dense thin films were synthesized, and the relative proportion, nanostructure, and local order was easily controlled through adjustment of the nucleation conditions for the two phases, and can be further patterned via the straightforward application of known lithographic techniques. The capability to control the configurations and alignments of CNTs, and the success to grow CNTs and UNCD simultaneously, provides a novel approach to fabricate “self-assembly” nanostructured carbon materials. The hybrid nanocarbon materials have the potential for technololgical applications such as materials for hydrogen storage and membranes fuel cells and electrodes in supercapacitors in order to increase the energy conversion efficiency.

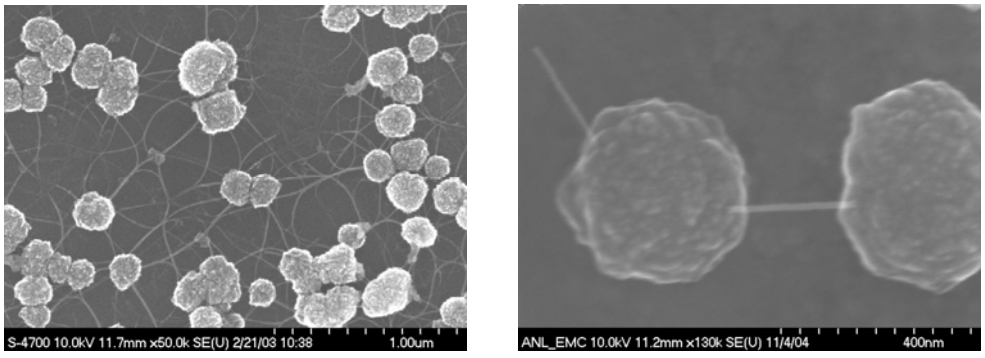

Figure 1. The simultaneous growth of ultrananocrystalline diamond and carbon nanotubes